signing works for dealing with effluent. The quantity of air and depth of filter are two other conditions that must be considered. Surface condition can be varied by the size of materials, and to prevent organic matter accumulating in the interstices a sufficient time must elapse between the discharges, so as to provide for the liquefaction of the organic matter in suspension, in order that no more should pass into the body of the filter than the lower zones can dispose of. This shows the necessity for periods of rest sufficient to prevent accretions of organic matter from clogging the top surface of filter-beds, and 7½ minutes was found sufficient for the purpose at Ashtead. At Staines, Mr. Hall informed Mr. Scott-Moncrieff, it was found that 7 minutes was sufficient in summer; but when, in October, there was considerable discharge from the breweries into the sewers, it was found necessary to increase the periods of rest to 15 minutes.

As another instance of the need for varying the design of filter-beds to meet different conditions of sewage, the case of Hanley may be quoted. Here, we are told, marvelous results were obtained with small particles of filtering material over a period of three years, without interruption of any kind, the sewage being weak in character. When tried at Staines, the same size of material proved worse than useless. Mr. Scott-Moncrieff had advised for Hanley a period of rest of 7½ minutes. It had been suggested—and the proposal had obtained official sanction—that a filter-bed might, apparently, be increased to no less than 12 feet in depth, in the belief that there might be treated a quantity of sewage corresponding to the depth of filter. That, Mr. Scott-Moncrieff pointed out, might possibly be true for filters composed of large materials throughout, including that upon the surface; but, as the proposition ignores surface conditions, it could not possibly be right for the weaker kinds of sewage, with which fine particles give the best results. Pooling of the sewage on the surface would cause a complete upsetting of the whole process, with a probable destruction of the bed in regard to its bacterial activity.

[Concluded from Supplement No. 1636, page 26215.]

THE MANUFACTURE, DENATURING, AND THE TECHNICAL AND CHEMICAL UTILIZATION OF ALCOHOL.—II.

By M. Klar, Chief Chemist of F. H. Meyer, Hannover-Hainholz, Germany.

From the foregoing table it will be seen that the manufacture of alcohol, for instance, from corn, comprises the following phases: The cleansing of the raw materials (corn and barley) from dust, dirt, etc., and the storing of the same in suitable lofts and bins. The gelatinization of the corn by steaming under pressure. The production of diastase for the saccharification of the gelatinized starch, by means of green malt prepared from cleansed, steeped, and germinated barley on the malting floor or in the pneumatic malting plant. The production of malt milk from the green malt in suitable apparatus. The production of the fermenting yeast necessary for the fermentation of a portion of the sweet mash in the yeast room. The sterilization and saccharification of the sweet mash in the mashing vats, by means of the malt milk. The fermentation of the saccharified mash by means of an admixture of fermenting yeast in the fermenting vats. The distillation of the alcohol from the fermented mash obtaining the wash at the same time, and the rectification of the spirit.

The raw materials are raised by means of an elevator to the cleansing machine, located above the storing room, where they are freed from dirt, dust, etc., and are then transported by means of a distributing conveyor to the bins or silos, usually constructed of wood and provided with suitable hopper outlets. The granary for the storing of the barley is similar to that used for the corn and is situated above the steeping room and the malting floor.

The first step in the operation of the plant is the production of the malt, as this operation requires from 10 to 25 days according to the character of the malting, either upon the ordinary malting floor or in a pneumatic malting installation. The purpose of the malting is to obtain the ferment called diastase, necessary for the conversion of starch into sugar. The diastase arises from the albumen of the germinating grains.

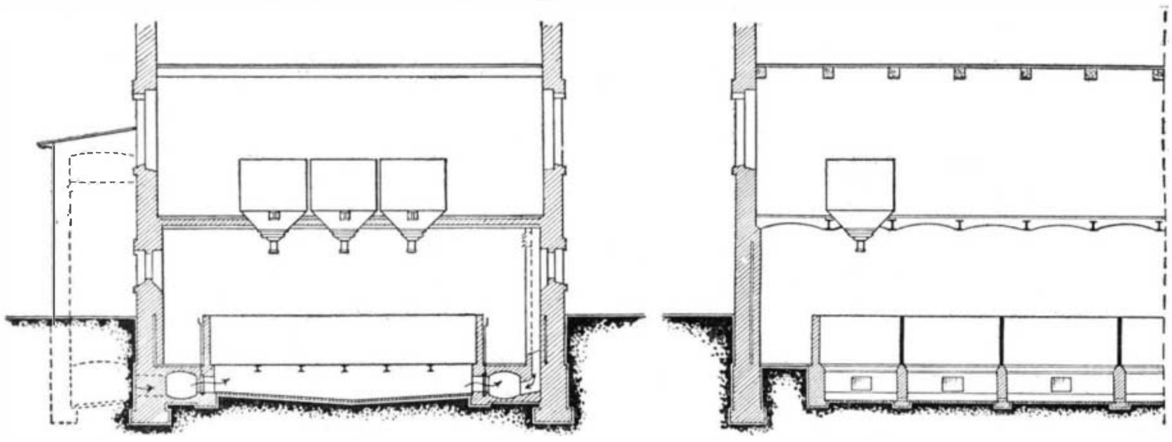

Fig. 5.—A PNEUMATIC MALTING PLANT.

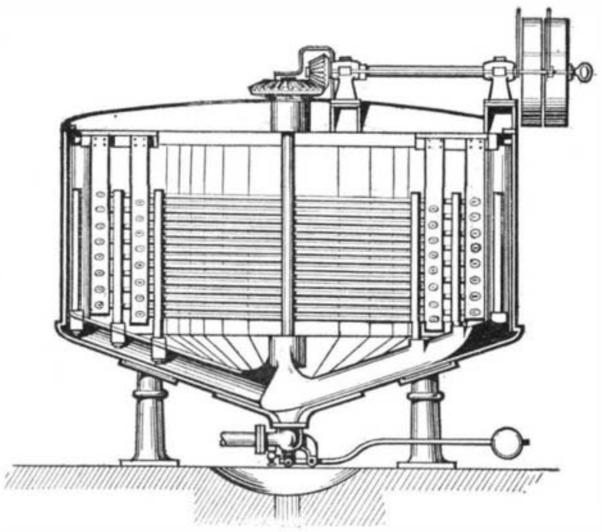

Fig. 4.—MODERN MASHING VAT.

THE MALTING PROCESS.

The cleansed barley is first steeped in special steeping vats constructed either of brickwork or, preferably, of iron. In these vats which, at the same time, permit the cleansing of the grain and the removal of sterile or dead grains, the barley is allowed to remain with the requisite quantity of water for two to three days, according to the temperature. About 40 to 45 per cent of the grains germinate. When the grains begin to germinate they are placed, if the older method is followed, in flat heaps upon the germinating floor, and are from time to time turned with a shovel. The temperature of the grain at various stages of the process serves as a guide, and it should, at no time, be permitted to exceed 63 deg. F. Furthermore, if necessary, the evaporated moisture must be replaced by sprinkling, and provision must be made for the thorough ventilation of the malting floor, as the germinating process is accompanied by the production of carbonic acid, the accumulation of which is injurious to the health of man, and at the same time is prejudicial to the development of the malt.

In germination a portion of the starch of the grains is consumed with the production of carbonic acid and water. Another portion of the starch is converted into maltose. The albumen also undergoes certain changes, being converted partly into soluble albuminous substances, which later serve as nutrients for the yeast, and partly into diastase, the ferment serving for the saccharification of the starch. The malting process with modern methods lasts from 20 to 25 days.

To avoid the long germinating period necessary under the old methods of malting, pneumatic malting has been adopted in late years. In the pneumatic system of malting the thoroughly steeped barley is placed in wide cases constructed of brickwork and having perforated bottoms, preferably of zinc-covered iron. At both sides of each box are channels, one of which communicates with the blower, so that air under compression, saturated with moisture, and at any desired temperature can be forced under the perforated bottom, and after penetrating the germinating grain allowed to escape by means of an outlet thereabove. The other channel is connected with another fan, and through it the cold air can be drawn off from the top to the bottom through the germinating grain in order to cool the same.

By means of this apparatus the malting process is

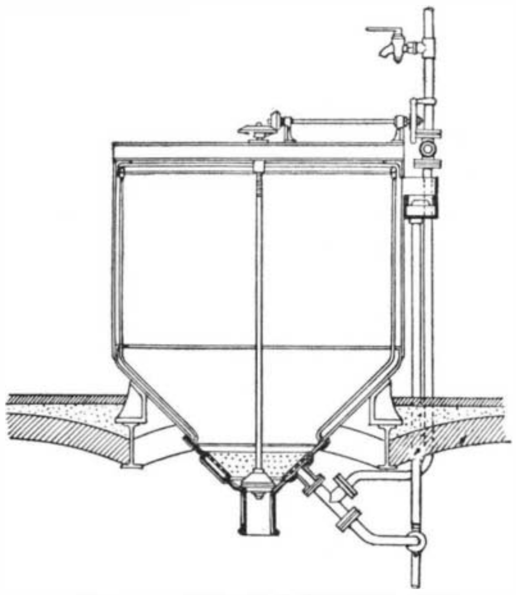

Fig. 1.—GRAIN STEEPING VAT.

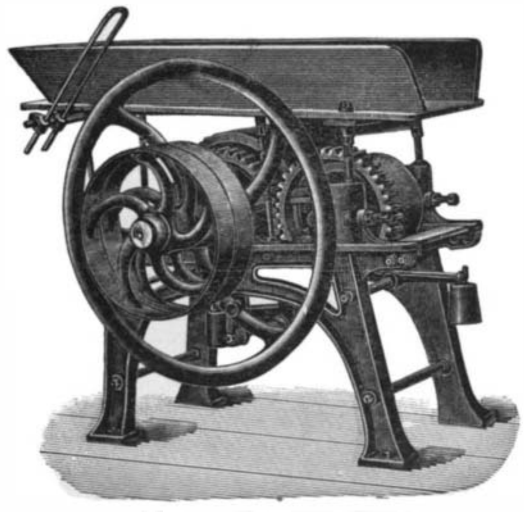

Fig. 2.—GREEN MALT CRUSHER.

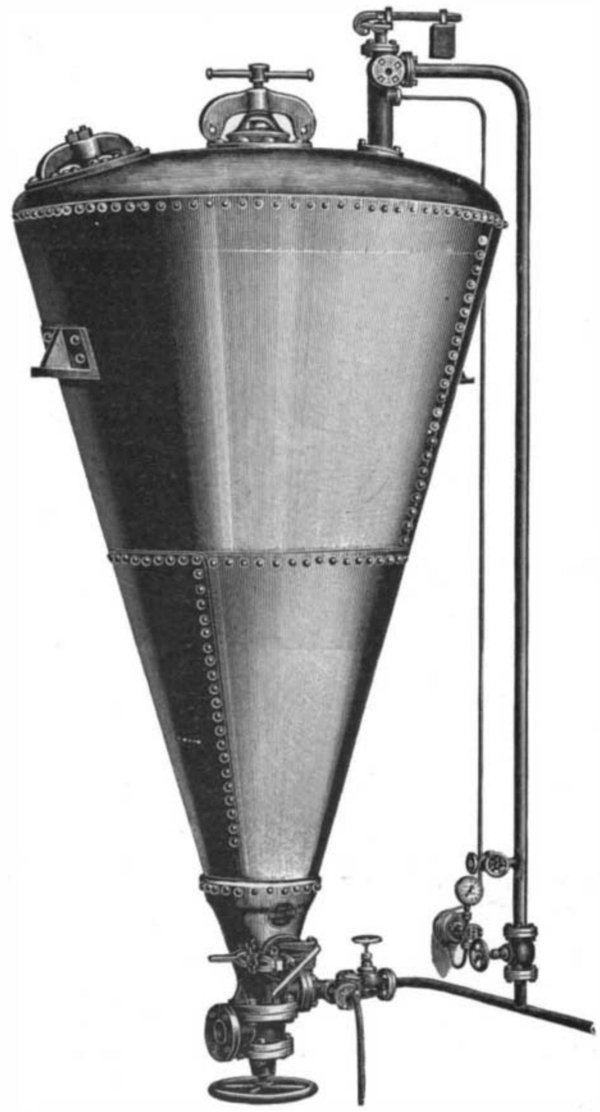

Fig. 3.—MODERN HENZE STEAMING APPARATUS OF CONICAL SHAPE.

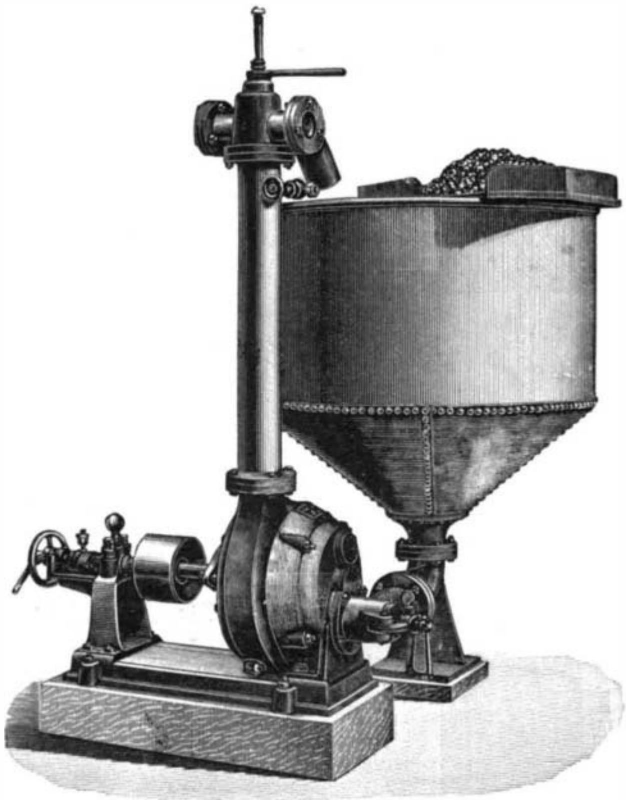

Fig. 6.—MALT MILK APPARATUS OF THE BOHM TYPE.

rendered independent of the temperature of the air, and it is for this reason especially suited for extensive plants, as well as for use in hot countries. Not only is much space saved thereby, but it is also possible to complete the malting process in about ten days, effecting a considerable saving over the older method lasting from 20 to 25 days.

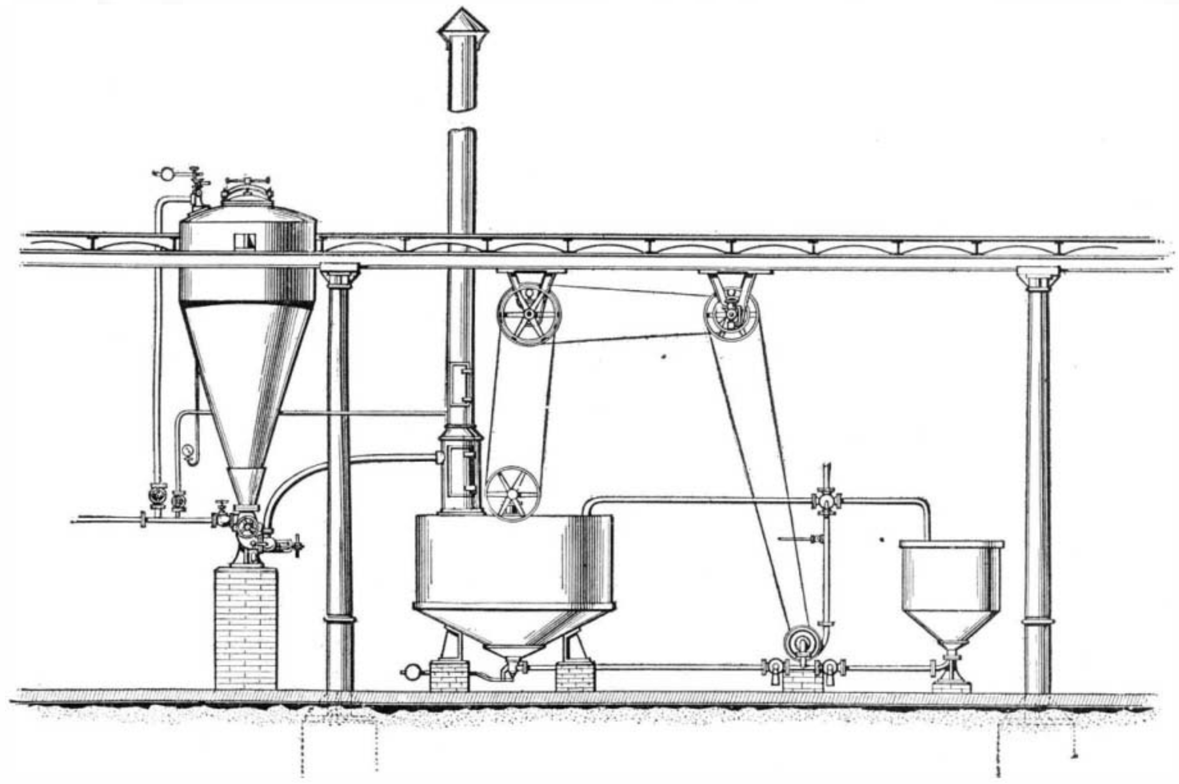

FIG. 7.—STEAMING, MASHING AND MALT YEAST APPARATUS.

From 100 pounds of barley about 145 pounds of so-called green malt are obtained. The green malt, as it contains considerable moisture, cannot be preserved for any length of time, and, therefore, under certain circumstances it is necessary to dry it. The drying process is effected by means of hot air, at a temperature of about 122 deg. F., and it must be conducted with great care in order to insure the preservation uninjured of the diastase. From 100 pounds of barley about 82.5 pounds of dried malt can be obtained. In general, green malt is preferred to dried malt as, despite the greatest care, a certain part of the diastase is almost always rendered ineffective by the drying process.

The green malt as it comes from the malting floor is not in condition to be added to the gelatinized starch. It must first be passed through a malt crushing apparatus, and then turned into malt milk in machinery which emulsifies it with water.

THE GELATINIZATION OF THE RAW MATERIAL.

The anatomical construction of the grains of corn is such that the diastase cannot effectively act upon the starch contained therein until the tissue of the cells is broken down to enable the diastase to come into direct contact with the starch granules. In order to break down the cellular tissue of the grains, it is necessary to steam the corn under a pressure of from three to four atmospheres. The apparatus used for this purpose is known by the name of its original constructor, Henze. The Henze steamer consists substantially of a conical vessel constructed of iron and designed to stand a heavy internal pressure. The larger sizes, and especially the forms used in connection with crushed corn, are provided with agitating or stirring devices. A steamer of the largest size has a capacity of nearly 40 bushels, or about 1,000 gallons. To work 35 tons of corn per day six steamers of this type are necessary, each working one ton or about 40 bushels of corn in each operation of four hours' duration. By means of a suitable elevator the corn is transported from the bin to measuring apparatus, which automatically discharge when one ton has been weighed out. From the measuring apparatus the corn is conveyed to the Henze steamer, into which 315 gallons of hot water have already been introduced for each ton of corn. The steamer is then closed, a small blowoff valve only remaining open. Steam is then introduced through a steam distributing device, and the corn is boiled until it becomes pulpy, the process lasting about an hour. The delivery cock is then regulated so that the boiling continues under a pressure of two to three atmospheres for a further period of an hour. The pressure is finally increased to four atmospheres, the delivery cock being completely closed, and this extreme pressure is maintained for about half an hour. When the boiling or steaming operation is completed, the steamers are emptied into the mashing vats. These have already been partly filled with the malt milk. The steamers are emptied of the gelatinized cornstarch under full pressure, the mass therein being blown out through grates with sharp edges inserted in the blowout pipe to effect a complete maceration of the grains of corn.

SACCHARIFICATION OF THE RAW MATERIAL.

Usually one mashing vat is provided for every two Henze steamers. The vat consists of a closed vessel with a conical bottom, and a suitable inlet opening for the material. Inside of the vat is located a cooling contrivance consisting of oval coils of copper pipe and a powerful agitating device.

In the mashing vat the disintegrated starch is thoroughly mixed with the malt milk, whereby the starch is converted into sugar by means of the diastase. The mash is cooled to the fermenting temperature after the completion of saccharification. If the material from the steamer came directly into contact with the malt milk, the malt would be scalded in part by the excessive heat, whereby the diastase would be rendered ineffectual. For this reason the starchy mass must be cooled before it is introduced into the mashing vat. This is effected in the blowout apparatus of the steamer by the exhauster, which is provided with a suction injector drawing toward the mass, passing

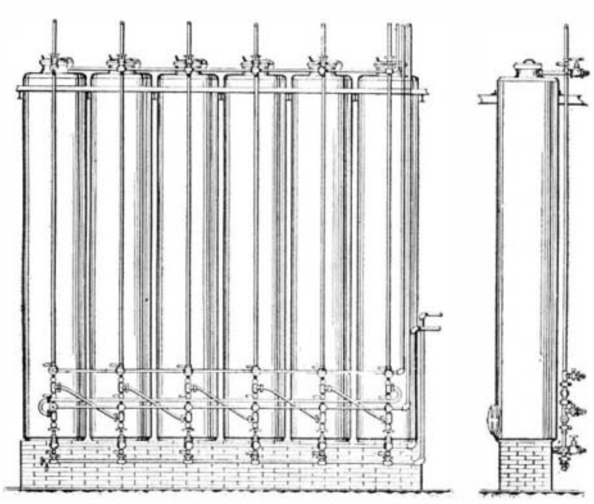

FIG. 9.—ALCOHOL FILTER BATTERY.

through the blowout pipe a powerful stream of air; thus the vapors are drawn off, and at the same time the mass itself is cooled.

As the diastase is liable to be injured at temperatures exceeding 149 deg. F., the temperature of the mass must be rapidly brought to a temperature of 122 deg. F. The temperature must then be increased slowly and carefully to 144 deg. F. Toward the end of the saccharifying process the temperature is increased to 126 deg. F. in order to destroy inimical ferments that may be present in the mash. At this stage of the proceeding about one-twelfth of the volume of the sweet mash is taken from the vat to be used in the production of fermenting yeast.

The mash is cooled as quickly as possible, by means of the cooling apparatus within the vat, to 86 deg. F., and an equivalent quantity of fermented yeast is added. The cooling is continued to 66 deg. or 70 deg. F. The entire operation lasts about four hours. When the sweet mash has been cooled to this temperature, it is pumped into the fermenting vats, of which there are eighteen, each containing 8,000 gallons and equal in capacity to three mashing vats and six Henze steamers.

PRODUCTION OF THE YEAST.

The sweet mash taken from the mashing vat is pumped into one of nine vats in the yeast room. It has a concentration of 22 deg. to 24 deg. by saccharometer, and consists largely of maltose. Lactic acid fermentation is now induced, the temperature being kept at 122 deg. to 125 deg. F., as this offers an excellent protection against all organisms inimical to fermentation.

When beginning the operation, in order to excite the lactic acid fermentation, pure cultures of lactic acid bacteria are added to the mash. Later certain quantities of fermenting lactic acid are removed from the vat undergoing normal lactic acid fermentation to serve for the induction of subsequent fermentation. Each yeast fermenting vat contains refrigerating coils which can be agitated to insure thorough cooling, and which can be used for heating purposes by the introduction of hot water or steam therein. After about twenty-four hours the lactic acid fermentation process is completed, and the final step consists in heating the mash to 167 deg. F. to sterilize it. After this it is cooled as rapidly as possible to a temperature of 86 deg. F. A suitable quantity, about one-tenth of the mass contained in the fermenting vat, of mother yeast or pure culture yeast is added. The cooling is continued to 64 deg to 68 deg. F. The fermentation is continued to 4 deg. to 5 deg. by saccharometer, with thorough aeration and agitation of the mass. After the fermentation reaches 4 deg. to 5 deg. saccharometer a quantity of mother yeast is removed for the subsequent yeast production, and the rest is transferred to the fermenting vat already filled with cooled sweet mash.

FERMENTING THE SWEET MASH.

The fermenting vats in a plant of the size we are describing are eighteen in number, each containing about 8,000 gallons. The fermentation lasts about three days and consists of three phases: 1. Prefermentation, consisting principally in the formation of yeast in the mash necessary for the second phase. 2. Chief fermentation, the conversion of the maltose present into alcohol and carbonic acid. 3. After-fermentation, in which the diastase acts upon the dextrin present, saccharizing and fermenting it.

The fermenting vats, like the yeast vats, are provided with movable coils, by means of which cold or hot water or steam as required can be circulated in the fermenting mass. By the movement of the coils the fermenting mass can be thoroughly aerated to permit the necessary escape of the carbonic acid, which must be removed from the room by proper ventilation. During pre-fermentation the temperature of the fermenting mass should be kept at about 66 deg. to 70 deg. F., during chief fermentation at 82 deg. to 86 deg. F., and during after-fermentation at about 79 deg. to 82 deg. F. The fermentation itself is considered at an end when the saccharometer reading has fallen from about 22 deg. to 1½ deg.

PRODUCTION OF ALCOHOL FROM THE MASH.

From the schematic outline above, it appears that

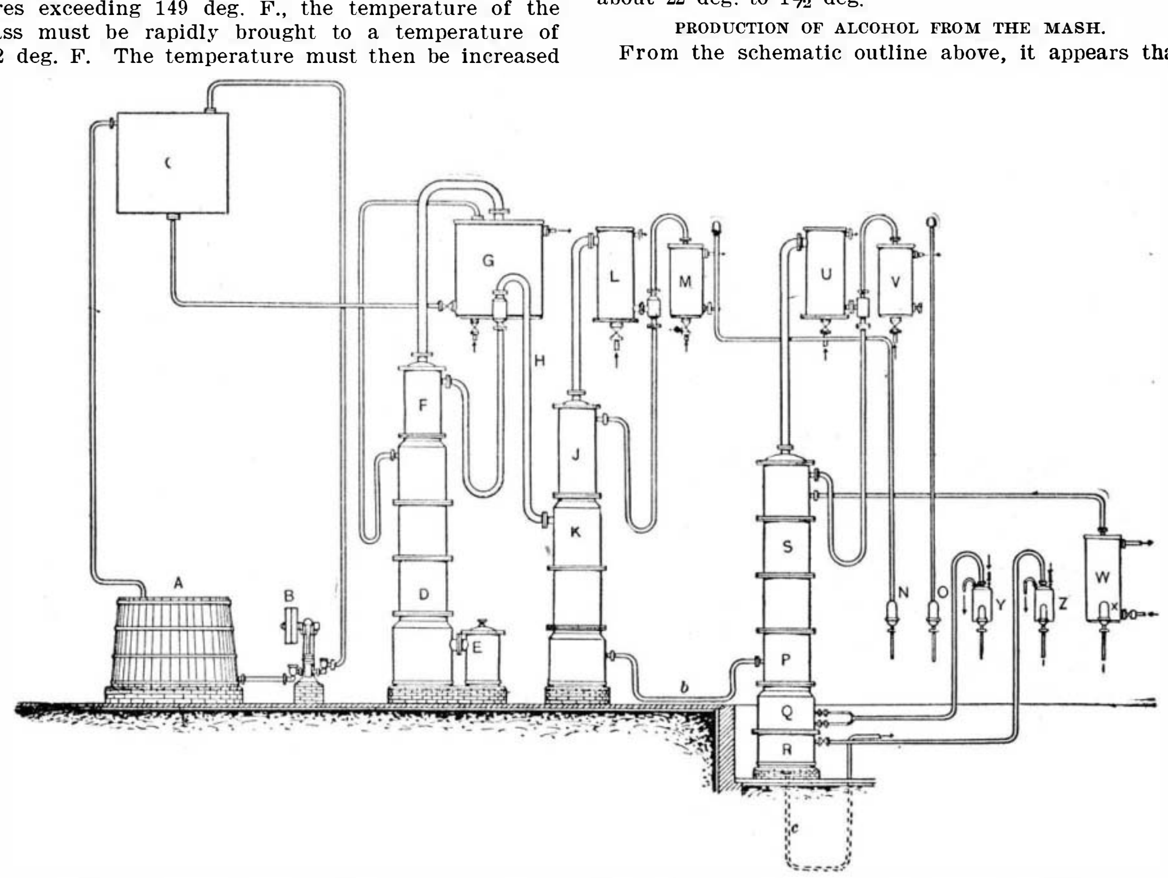

FIG. 8.—COMPLETE CONTINUOUS DISTILLING AND RECTIFYING APPARATUS.

the fermenting process yields per ton 1,100 gallons of fermented liquid of 1 deg. to 1½ deg. by saccharometer, and containing the volatile products, as well as the unchanged non-volatile constituents of the mash and the yeast. The constitution of the fermented mash is as follows:

	Per cent.
Mineral substances	0.6
Nitrogenous substances	2.4
Fibers	1.2
Extractive substances	5.8
Fat	1.0
Alcohol and by-products	9.0
Water	80.0

To remove in a concentrated form the alcohol contained in the fermented mash, the latter is subjected to repeated distillation, leaving the wash as a residue. The distilling process is based upon the difference between the boiling points of water, alcohol, and the by-products. The boiling point of water is 212 deg. F., and of alcohol 174.2 deg. F.

Distilling apparatus is based upon the principle that in bringing an alcoholic liquid to the boiling point, the vapors which rise therefrom, in consequence of their lower boiling points, contain more alcohol proportionately than the original liquid. Thus, a solution of alcohol of 10 per cent returns a 50 per cent distillate, and the 50 per cent solution in turn a distillate of 88 per cent; the latter finally returns a distillate of 92 per cent by weight, or 94 per cent by volume. Thus, in order to obtain from a 9 or 10 per cent mash 94 per cent spirit by means of an ordinary still and cooler, four or five distilling operations are necessary. It is obvious that this is neither a simple nor easy method of operation. Modern apparatus does away entirely with repeated distillation, the apparatus being continuous. The vapors pass through several stills, as it were; the vapor entering the first still, and containing the greater part of the alcohol, is condensed to a hot liquid and revaporized, the process being repeated in the subsequent stills. In this way the process consists of repeated vaporizations and condensations, the number depending upon the number of stills, and from the last of these the concentrated spirit is withdrawn. The column distilling apparatus is similar in principle, consisting essentially of a plurality of stills as described above. The contrivances within the column apparatus are equivalent to a great many stills placed one above the other, and provided with overflow outlets from one to the next below. The advantage presented by this system is that there is no necessity for having a particular cooler for each still in order to condense the rising vapor for the purpose of renewed vaporization. In the column apparatus a single common cooler is placed above the last still, and delivers the pure concentrated alcohol. This cooler or rather concentrator effects the cooling of the distillate from the last of the stills; and while only a relatively small portion is received from the cooler in a condition for use, the remainder or greater portion, at a relatively low temperature, returns to the column for redistillation. In the latter the vapor is condensed in rising from chamber to chamber by the already condensed liquid therein, and in passing from chamber to chamber is materially strengthened, merely by coming into contact on its way through the column with the concentrated liquids passing in the opposite direction.

According to the construction of the apparatus with this type of still, it is possible to obtain 92 to 93 volume per cent spirit containing 0.3 to 0.5 per cent of fusel oil, or even chemically pure 96 volume per cent alcohol from an alcoholic liquid of any concentration. In these stills the operation is continuous, and any source of heat can be utilized:

	Color.	Reaction.	Volume Per Cent of Alcohol	Per Cent Fusel Oil
Raw Spirit........	Colorless or Slightly Yellowish.	Neutral.	87 to 93	0.2 to 0.6
Refined spirit or pure alcohol....	Colorless.	Neutral.	96 2	None.

The choice of the distilling apparatus depends upon whether raw spirit or pure alcohol is to be manufactured. If the plant is a small one, the manufacture of raw spirit only is generally undertaken therein. This raw spirit is either sold directly for denaturation, or goes to special refineries, where it is purified through the removal of the fusel oil.

During late years the construction of distilling apparatus and plants has been so perfected, that it is possible to obtain in a single operation pure alcohol in no way inferior to the spirit obtained by two or more operations with periodically working apparatus. In this country if it is desired to manufacture alcohol under the new tax-free alcohol law for purposes of denaturation, a plant utilizing 40 or more tons of corn per day should by no means content itself with the production of raw spirit. Even in smaller plants the manufacture of pure alcohol by means of the perfected apparatus obtainable will be of great advantage. Primarily, the cost is not much greater than that of manufacturing raw spirit, and the advantages in regard to salability, higher price, etc., are manifest.

Among the accompanying illustrations is an example of the latest type of apparatus for the distillation of pure alcohol directly from the mash—a continuous still manufactured by F. H. Meyer, Germany. The fermented mash is raised by the mash pump from the reservoir *A* to the distributing reservoir *C*, provided with an overflow to *A* for the purpose of maintaining a constant level. The mash, serving as cooling means, enters the cooling apparatus of the column *F D*, and from there in a preheated condition through the siphon tube into the lower column *D*. Here the volatile constituents are concentrated to about 50 per cent, part being cooled and returned from *G* to *F* to continue the rectification. A concentrated portion goes to *H*, where it is condensed and introduced in a heated condition into the upper part of the column *K*. The volatile constituents, such as aldehyde, accumulate in the upper column *J*, and by the effect of the cooler, the main part of the vapors containing aldehyde from *J* are continuously returned to *J* for renewed rectification, an equal part of the vapors arising from *J* being condensed by *M* and withdrawn through the sight glass.

The remaining hot spirit, freed from the more volatile by-product but charged with the less volatile constituents, passes through the pipe *b* into the lower part *P* of the third column *S P Q R*, encountering steam entering from below. Here the final separation of the by-products is effected in the section *Q*, the resulting distillates flowing continuously to the cooler *J*, and being withdrawn there in the form of concentrated fusel oil. The spirit vapors thus freed from fusel oil, but still containing other more volatile constituents, accumulate in the column *S*. The portions which accumulate in the three uppermost sections are continuously eliminated by means of the coolers *U* and *V*, and are finally removed. The purest alcohol comes from the apparatus below the three uppermost sections of *S*, and is removed by the pure alcohol cooler *W*. The cooler *Z* is merely for the purpose of controlling the steam introduced into *R* and removing condensed steam as spindlings by the pipe *C*, no alcohol passing off with it.

Distilling apparatus of this type are provided with easily visible controlling devices as well as automatic regulators for all the inlets and outlets. But one man is necessary for its operation, and when the apparatus is once put in operation it will continuously produce pure alcohol from the mash directly, with practically no supervision. Apparatus of this character is, of course, expensive, but in view of the great advantages it presents, and the economies possible by means of it, the investment is a sound one. When the alcohol produced is intended for internal consumption, the product is, of course, filtered over charcoal after dilution.

[Continued from SUPPLEMENT No. 1636, page 26219.]

THE INFLUENCE OF PHYSICAL CONDITIONS IN THE GENESIS OF SPECIES.*

By JOEL A. ALLEN.

As already stated, geographical variation in color may be conveniently considered under two heads. While the variation with latitude consists mainly in a nearly uniform increase in one direction, the variation observed in passing from the Atlantic coast westward is more complex. In either case, however, the variation results primarily from nearly the same causes, which are obviously climatic, and depend mainly upon the relative humidity or the hygrometric conditions of the different climatal areas of the continent. In respect to the first, or latitudinal variation, the tendency is always toward an increase in intensity of coloration southward. Not only do the primary colors become deepened in this direction, but dusky and blackish tints become stronger or more intense, iridescent hues become more lustrous, and dark markings, as spots and streaks or transverse bars, acquire greater area. Conversely, white or light markings become more restricted. In passing westward a general and gradual blanching of the colors is met with on leaving the wooded regions east of the Mississippi, the loss of color increasing with the increasing aridity of the climate and the absence of forests, the greatest pallor occurring over the almost rainless and semidesert regions of the Great Basin and Colorado Desert. On the Pacific slope north of California the color again increases, with a tendency to heavy, somber tints over the rainy, heavily-wooded region of the northwest coast.

Geographical variation in color among mammals, for reasons already stated, is generally, but not always, manifested merely through the varying intensity or depth of the tints. It is, however, often strongly marked. The common chickaree, or red squirrel (*Sciurus hudsonius*), for example, which ranges from high northern latitudes southward over the northern portion of the United States, shows an increase in the color over the middle of the dorsal surface from pale yellowish or fulvous to rufous. The fox squirrel of the Mississippi Valley (*Sciurus niger, ludovicianus*), which ranges from Dakota southward to the Gulf of Mexico, has the lower parts, at the northward, very pale yellowish white, which tint gradually increases in intensity southward till in Louisiana it becomes deep reddish orange, the dorsal surface also becoming at the same time somewhat darker. Excepting the fox squirrels and a Pacific coast variety of the chickaree, all the squirrels living north of Mexico have the lower parts white, while those inhabiting tropical America have the lower parts fulvous, deep golden, orange, or even dark brownish red, specimens with the belly white being exceptional, though occasionally occurring in several of the species.

Mammals tend strongly to run into melanitic phases, which are especially developed at particular localities or over limited regions, but whether or not the result of geographical influences is not clearly evident. The whitening of the pelage in winter at the north in a considerable number of species of mammals and in one genus of birds, and not elsewhere, is, on the contrary, a strictly geographical phenomenon, but seems to be the result of other than the ordinary causes of geographical variation in color. Its occurrence in some species and its absence in others closely allied to them is a fact not readily explained. It shows, however, how differently different animals are affected by the same influences. The change to a white winter livery is more complete in the higher latitudes, where the whiteness pervades the pelage to a greater depth and continues for a longer period, the change being only partial in the southern representatives of species that exhibit this seasonal change of color.

In respect to southward increase in color among birds, a few examples only out of the many almost equally striking can be here given. These will be chosen from widely different groups and will represent localities remotely separated, as well as very diverse styles of coloration. In comparing, for instance, New England examples of the common quail with others from southern Florida the colors are found to be so much stronger and darker in the southern birds as to give the appearance of their being entirely distinct species, particularly when the smaller size and larger bills of the southern race are also considered. While in the northern birds the color of the dorsal surface is gray and rufous, slightly varied with black, the gray is wholly wanting in the southern type, the rufous is much stronger, and the black markings are very much broader. The lower surface is varied by transverse bars of black and white, but while in the northern birds the white bars are twice, or more than twice, the width of the black ones, in the southern birds they are often of equal width; or the black bars may be the broader, with much more black bordering the white throat patch, giving, on the whole, a very much darker aspect to this region of the body. Yet when a series is brought together from many intermediate localities, there is found to be a complete intergradation between the most extreme phases. In the common towhee the style of coloration is entirely different from that seen in the quail, the colors being chiefly massed in large areas, with white markings on the wings and large white spots at the ends of the outer tail feathers. In this species southern specimens differ from northern ones in the black of the upper parts and the chestnut of the sides being more intense, while the white markings on the wings and tail are greatly reduced in area. In the northern bird, four of the outer pairs of tail feathers have a large white spot near the end, while in the southern form only three pairs are thus marked.

In the purple grackle the plumage (in the males) is everywhere black, with, at the north, greenish or bronzy reflections; in the southern or Floridan form the black is more intense, and the reflections are steel blue and purple, with iridescent bars across the middle and lower parts of the back. In the northern form the female is dull brownish-black, with little or no iridescence, while in the southern form the female is nearly as lustrous as the northern male. The two types differ so widely, not only in color, but, as previously noticed, in size and in the form of the bill, that, without the connecting specimens from intermediate localities, no ornithologist would hesitate to regard them as entirely distinct species; and they were, indeed, at one time so regarded. The red-winged blackbird has, excepting its red wing patches, also a lustrous black plumage throughout, and presents a similar range of variation in general color with the preceding; while the red of the wing patch becomes much darker at the southward, and its creamy-white border seen in the northern form changes to yellowish-orange in the southern.

The common blue jay, and the long-crested jays of the Rocky Mountain region, may be cited as illustrations of southward increase in brilliancy or intensity of coloring where the prevailing tint is blue; the green Mexican and Rio Grande jays of a passage from yellowish-green tints into bright yellow; the yellow-throated warblers (genus *Geothlypis*), several of the flycatchers (genera *Myiarchus* and *Tyrannus*), and the meadow lark, as examples of increase in the area and intensity of yellow; several of the woodpeckers (genera *Centurus* and *Sphyrapicus*), the cardinal finches (genus *Cardinalis*), and some of the tanagers (genus *Pyranga*), of a similar increase of red; the goldfinches (genus *Chrysomitris*), and most of the species above named, of increase in extent and purity of black areas. The Rocky Mountain jays have, at the northward, a large portion of the plumage rather dark ashen, which farther southward becomes bluish ash, and still farther south culminates, in the Central American States, in blue. In the genus *Geothlypis*, the Maryland yellowthroat (*G. triches*), which ranges over the whole United States, and thence far southward, has at the northward the abdomen whitish; more to the southward, yellowish; and, in the West Indies, Mexico, and northern South America, runs into races in which the abdomen is bright yellow. At the same time the black markings about the head increase in extent and purity and the general size becomes larger, the group having its metropolis in the tropical regions. In consequence of these variations in color and size this species at the southward becomes differentiated into several more or less well-marked subspecies (formally accorded full specific rank), which are connected by an unbroken series of intergradations.

In the great-crested flycatcher (*Myiarchus crinitus*)

* Reprinted, with note and bracketed additions by the author, from the Smithsonian Institution's Report.